



# Introduction to the feature issue on augmented/virtual reality: optics & photonics

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**Abstract:** In recent years, augmented/virtual reality (AR/VR) has been attracting attention and investment in both the tech and academic communities, kickstarting a new wave of innovations. In the wake of this momentum, this feature issue was launched to cover the latest advances in this burgeoning field that pertains to optics and photonics. Alongside the 31 research articles being published, this introduction is appended to share with readers the behind-the-issue stories, submission statistics, reading guides, author biographies, and editors' perspectives.

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## 1. Issue preparation

For a long time, AR/VR had been seen as a low-profile or marginal topic, not attracting much attention from the optics and photonics community. In many journals and conferences, AR/VR was often subordinate to other topics, *e.g.*, 3-dimensional (3D) displays. However, beginning a few years ago, we have been witnessing a boom in the interest towards AR/VR. Many of our colleagues from different fields are pivoting to AR/VR. More and more journals and conferences have been allocating AR/VR as special topics. Therefore, in March 2022, we reached out to Prof. James Leger (editor-in-chief of *Optics Express*) to propose a special issue on AR/VR. With input from Prof. Leger and Prof. Thomas Murphy (senior deputy editor), we determined the title and topics of this issue. In June 2022, the proposal was approved and the issue was officially launched by opening submissions in Prism.

## 2. Statistics of submissions

From June to October of 2022, we received a total of 60 submissions, of which 31 were accepted. The acceptance rate was 52%. By our estimate, 340 authors, 106 reviewers, 8 editors, and 11 staff members were engaged in this issue. The first and last articles were published on 8 August 2022 and 24 January 2023, respectively. The top three countries/territories—where the corresponding authors of published papers are located—are China (71%), United States (13%), and Republic of Korea (tie) (6%) or Taiwan (tie) (6%). The tied countries/territories are written in alphabetical order. The median time from submission to publication was 66 days. The overall duration of the special issue, from the announcement to final completion, was 8 months.

## 3. Reading guides

For readers to conveniently find articles of greatest interest, we have sorted the submissions to correspond to the most relevant topics that were solicited in the announcement of the feature issue [1].

- Topic 1. Increase of field of view: [2,3,4,5].  
Topic 2. Expansion/duplication of exit pupil: [6].  
Topic 3. Eyebox uniformity: [7].  
Topic 4. Fresnel lenses/pancake lenses/flat optics: [8,9,10].  
Topic 5. Vari-focal/multi-focal/zoom eyepieces/lenses: [11,12,13,14].  
Topic 6. Retinal projection/scanning: [15].  
Topic 7. Transparent/see-through displays: [16,17,18,19].  
Topic 8. Head-up displays: [20].  
Topic 9. Near-eye/head-mounted displays: [21,22,23,24,25,26].  
Topic 10. Intraocular implants/retinal prostheses/bionic eyes: [27].  
Topic 11. Optical simulation software/tools for AR/VR: [28,29].  
Topic 12. Metrology/measurement/benchmark/standardization for AR/VR: [30,31].  
Topic 13. Ergonomics/human factors/cybersickness for AR/VR: [32].

Three Editor's Picks ([12,23,31]) were nominated by the handling editor during the peer review stage. In addition, on January 9 of 2023, we conducted a poll among all 27 corresponding authors (CAs) to vote for their favorite articles. The top three articles are: [2] (voted by 9 CAs), [9] (tie) (voted by 5 CAs), and [23] (tie) (voted by 5 CAs).

#### 4. Author biographies

For readers to get to know the authors better, we contacted 27 corresponding authors for their biographies on 9 January 2023. At the time of writing, we have received biographies from 19 authors as follows.

Chao Ping Chen [2,27] is with Smart Display Lab of Shanghai Jiao Tong University. His research interests include AR/VR, biomimetic displays, near-eye displays, and flat panel displays. To date, he has published 59 SCI-indexed journal papers (first/corresponding author: 34), 8 EI-indexed/other journal papers, 83 international conference papers (invited: 16), 40 patent applications (granted: 22), and 1 software copyright. According to Google Scholar, his publications have been cited over 1100 times (*h*-index: 21).

Zhaojun Liu [3] is currently an associate professor in Department of Electrical and Electronic Engineering of Southern University of Science and Technology (SUSTech). He received a PhD degree in Hong Kong University of Science and Technology in 2011. He joined SUSTech in 2016 and founded the Center for Micro-LED Research. His research interests cover the wide bandgap materials and devices, Micro-LED advanced displays, and AR/VR/XR. He received SID's (Society of Information Display) Peter Brody Prize (2020), the Hong Kong 25th Anniversary Young Scholars of Innovation (2022) award, OGC's Optoelectronic Technology Innovation Award (2022), 1st place in the HKUST One Million Dollar Entrepreneurship Competition (2020), and 7 best paper awards in top conferences. He has published 120+ peer-reviewed journal and conference papers, 4 book chapters, and 200+ granted patents. He has delivered 40+ invited talks for academic and industrial institutions, including 4-hour short courses at SID Display week (2019), ICDT (2020, 2022). He is an IEEE Senior member and Fellow of Vebleo. He serves as chair of the SID Emissive, Micro-LED & QD committee and general secretary of Guangdong Micro-LED Alliance.

Jun Wang [4] is a professor at the College of Electronics & Information Engineering, Sichuan University, China. Before coming to Sichuan University, he worked as a postdoctoral fellow at the University of Wisconsin-Madison, Madison, USA. He studied Electronic and Computer Engineering at Hanyang University, Seoul, Korea, and received his PhD in Feb. 2011. His research interests are in holographic 3D displays, image encryption, and image compression.

Xiuguo Chen [5] is currently a full professor of Huazhong University of Science and Technology (HUST). He received his PhD degree in Mechanical Engineering from HUST in 2013. From 2013 to 2015, he was working as a postdoc in the same university. From 2016 to 2018, he was

working as a JSPS fellow at the Department of Nanomechanics, Tohoku University (Sendai, Japan). He has authored/co-authored more than 100 peer-reviewed journal papers and holds more than 30 patents. His research interests include ellipsometry and polarimetry as well as scatterometry for nanoscale characterization and metrology.

Shufeng Yan [7] received the B.S. degree in Optics from University of Science and Technology of China and the M.S. degree in Photonics from Friedrich Schiller University Jena, Germany. He is currently working toward the PhD degree in optical engineering in Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Science. His research interests include AR displays, simulation algorithms and metagratings.

Dewen Cheng [10] received his PhD degree in School of Optics and Photonics from Beijing Institute of Technology in 2011 and was a joint-PhD student in Optical science center in University of Arizona. He is now a professor in School of Optics and Photonics from Beijing Institute of Technology and CEO of Beijing Ned + AR Ltd. His research interest includes design and manufacture of free-form optics, waveguide near-eye displays and other advanced optic systems.

Miao Xu [11] is an assistant professor at the Hefei University of Technology. She received her BS in Polymer Science and Technology from Qingdao University of Technology in 2010, and her MS degrees and PhD degree in Polymer Nano-Science and Technology from the Jeonbuk National University in 2013 and 2016, respectively. Her current research interests include adaptive optics, liquid crystal lens, 3D display, polyvinyl chloride gels.

Lihui Wang [14] received the Ph.D. degree in information science and technology from the University of Tokyo, Japan. He was then a project researcher and project assistant professor at the same university. He is currently a professor at the Institute of Semiconductors, Guangdong Academy of Sciences, China. His research was endowed with the Special Prize from ACM SIGGRAPH, Innovative Technologies 2019 and the Sponsor Award from Digital Content Association of Japan. His current research interests include adaptive optics system, high speed vision, and dynamic interaction.

Guoqiang Lv [15] received the B.S. and M.S. degrees from the Department of Optical Instrumentation, Zhejiang University, Hangzhou, China, in 1983 and 1986, respectively. Since then, he worked in the School of Instrumentation, Hefei University of Technology, and became a professor in 2001. He was a senior visiting scholar at the Institute of Computer Technology of Vienna University of Technology, from 2001 to 2002. Since 2003, he has been the Dean of the Academy of Photoelectric Technology, Hefei University of Technology. His current research interests include holographic displays and 3D displays.

Juan Liu [18] received her MS in optics from Shanghai University, Shanghai, China, in 1998, and her PhD degree in diffractive optics from the Institute of Physics, Chinese Academy of Sciences, Beijing, China, in 2001. She was a visiting scientist at Institute of Medical Physics in University of Vienna, Austria, from 2001 to 2003; at University of Arizona from August to October 2014; at University of California at Berkeley from October 2014 to August 2015. From 2005 to 2008, she was an associate professor in Beijing Jiaotong University, Beijing, China. From 2008 to present, she is a professor in Key Laboratory of Photo Electronic Imaging Technology and System, Ministry of Education of China, School of Optics and Electronics, Beijing Institute of Technology, Beijing, China. Her major research interests include: 3D holographic display, diffractive optical elements, the design and fabrication of micro-optical elements, meta-surface elements, micro-/nano- optical elements and modulators.

Dayong Wang [19] is a professor at the Faculty of Science, Beijing University of Technology, lecturing undergraduate and graduate courses including Optics and Fourier Optics. His present studies are mainly related in optical information processing, optical imaging, digital holography, THz imaging and microwave photonics. During September-October 2016, he worked as a visiting scholar in the University of California, Los Angeles, USA. From December 2006 to November 2007, he worked as a visiting professor at Institut für Technische Optik, Universität

Stuttgart, Germany. From August 1998 to August 2000, he worked as a postdoctoral fellow at the Department of Physics of Complex Systems, Weizmann Institute of Science, Israel.

Dongdong Li [21] received his PhD degree in Materials Science from Shanghai Jiao Tong University in 2010. Under the support of the Ministry of Education of the People's Republic of China, he worked in the Department of Electrical Engineering at the University of Southern California (2007–2009). Currently, he is a professor at Shanghai Advanced Research Institute, Chinese Academy of Sciences. His research focuses on functional thin films with various nanostructures and tunable optoelectronic properties, for applications in advanced optics, high efficiency solar cells, neuromorphic devices, and so forth.

Cheng Yao [22] received his PhD degree in School of Optics and Photonics from Beijing Institute of Technology in 2021. He has been a post doctor in Beijing Institute of Technology and Beijing Ned + AR Ltd. since 2021. His research focuses on light-field near-eye displays and advanced free-form near-eye displays.

Jae-Hyeung Park [23] received his Bachelor of Science, Masters in Science and PhD from Seoul National University in 2000, 2002, and 2005, respectively. He worked as a senior researcher at Samsung Electronics from 2005 to 2007 and as an assistant professor at Chungbuk National University from 2007 to 2013. Since 2013, he has been with Inha University where he is now a professor. His research topic includes acquisition, processing, and display of three-dimensional information using holography and light field techniques. Recently, he has put more focus on optics for AR and VR near-eye-displays.

Jun Zhang [25] received the B.S. degree in physics from Minzu University of China, in 1990 and the M.S. and Ph.D. degrees in optics from Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP-CAS), in 1993 and 2005. From 1993 to 2005, she was an engineer and senior engineer with CIOMP-CAS. From 2005 to 2010, she was an associate professor with the Department of Optoelectronic Engineering, Jinan University, Guangdong, China. From 2010 to 2011, she was a research fellow with information engineering, the University of Electro-Communications, Japan. Since 2011, she has been a professor with the Department of Optoelectronic Engineering, Jinan University, Guangdong, China. She is the author of more than 150 articles, and more than 20 inventions. Her research interests include 3D imaging technology, novel micro/nano fiber based optical devices, all optical controllable devices, photoelectric information acquisition and processing, spectral analysis, optical design, machine vision, optical measurement and precision instrumentation.

Ni Chen [28] received the B.S. degree in software engineering from the Harbin Institute of Technology, Harbin, China, in 2008, the M.S. degree in electrical engineering from Chungbuk National University, Cheongju, South Korea, and the Ph.D. degree in electrical engineering from Seoul National University, Seoul, South Korea, in 2010 and 2014, respectively. She is currently an Associate Research Professor at James C. Wyant College of Optical Sciences, The University of Arizona. Her research interests include three-dimensional optical imaging and display.

Shu-Feng Lin [29] is an associate Professor at Collage of Applied Science Beijing University of Technology, Beijing, China. He received his PhD. Degree in 2018 from Department of Electronic Engineering, Kwangwoon University, Seoul, Korea. During 2018 to 2021, he worked as a Postdoctoral research Fellow at the School of Instrumentation and Optoelectronic Engineering, Beihang University, Beijing, China. His present studies are mainly related to optical information processing, especially in holography, 3D display, holographic imaging and THz light field manipulation.

Jiwoon Yeom [31] is a senior researcher at Korea Electronics Technology Institute (KETI). He received his B.S. (EE) degree and Ph.D. (EECS) degree from Seoul National University in 2010 and in 2015, respectively. From 2015 to 2017, he had been a senior engineer of Samsung Electronics in Korea where he is investigating diverse research topics including AR devices. His research interests cover near-eye displays (AR/VR) using holographic optical elements, as well

as refractive and reflective optical elements, and auto-stereoscopic displays such as light-field and holographic displays.

Zhenping Xia [32] received his B.S. degree in applied physics from Nanjing Normal University, Nanjing, China, in 2008, and his Ph.D. degree in Physical Electronics from Southeast University, in 2014. He is currently an Associate Professor of Electrical Engineering at the College of Electronics and Information Engineering, Suzhou University of Science and Technology, Suzhou, China. He spent a 1-year training period (from February 2010 to February 2011) at the High Impact Innovation Center of Philips CL, Eindhoven, the Netherlands. He was a post-doctoral research fellow from August 2017 to August 2018 at Schepens Eye Research Institute, Department of Ophthalmology, Harvard Medical School. His interests include flat panel display systems, 3D displays, virtual reality intelligent interaction, visual perception, medical image processing, aided diagnosis, image quality measurement, evaluation, and display characterization systems.

## 5. Concluding remarks

This issue was curated for all researchers who are currently interested in the research and development of AR/VR. To the best of our knowledge, it is the first time that the topic of AR/VR has been featured as a standalone issue across all Optica Publishing Group's journals. We hope this issue serves to inspire new colleagues to join the AR/VR community. More importantly, we believe that the multidisciplinary nature of AR/VR will be catalyzed by the cross-pollination of the ideas contained in this feature issue.

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